



# **Thermal Control Materials on MISSE-6 With Comparison to Earlier Flight Data**

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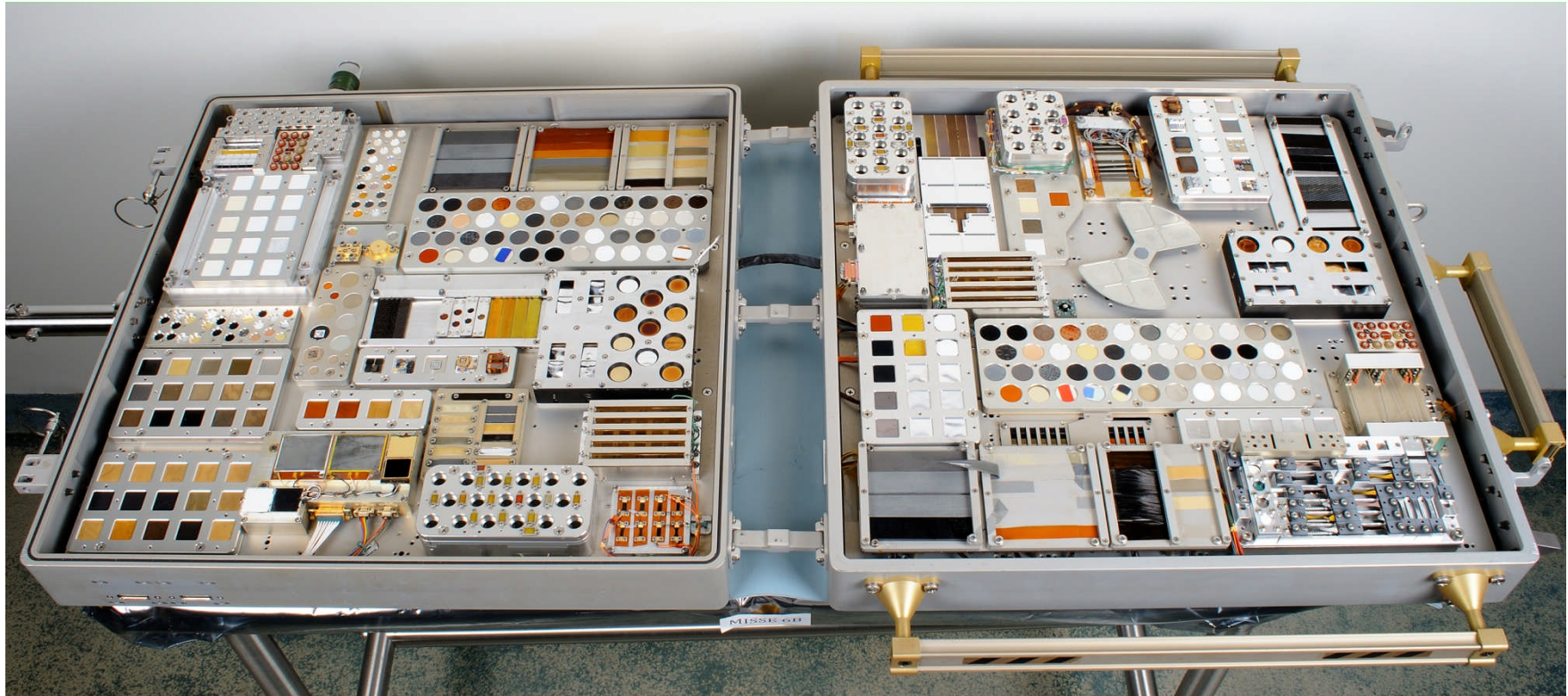
## Materials on International Space Station Experiment (MISSE) - 6

Deployed: March 13, 2008 on STS-123

Retrieved: September 1, 2009 on STS-128

- Materials' Location on MISSE-6
- Environmental Exposure
- Effects on Coatings
  - Thermal Control Coatings
  - Marker / Astronaut Visual Aid Coatings
- Discussion and Conclusions

## Thermal Control Materials on MISSE-6 With Comparison to Earlier Flight Data



MISSE-6B Wake / Ram

Photo courtesy of Langley Research Center

**Thermal Control Materials on MISSE-6  
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Ram-facing -  
AZ93 w/Teflon, AZ93,  
TMS800IY/TMJ-20LSB, AMJ760/AMJ750, AMJ600IR  
AZ400, MLS85LSB conductive, MLS85LSB



**Thermal Control Materials on MISSE-6  
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Wake-facing –  
AZ400,  
AMJ-700-IBU, MLS85LSB, MLS85LSB conductive,  
AZ93, AZ93 w/Teflon, AZ93 on Kapton



## Environmental Exposure

### Ram-facing side

- $\sim 2 \times 10^{21}$  atoms/cm<sup>2</sup> atomic oxygen (Kapton erosion)
- $\sim 2,600$  equivalent sun-hours UV

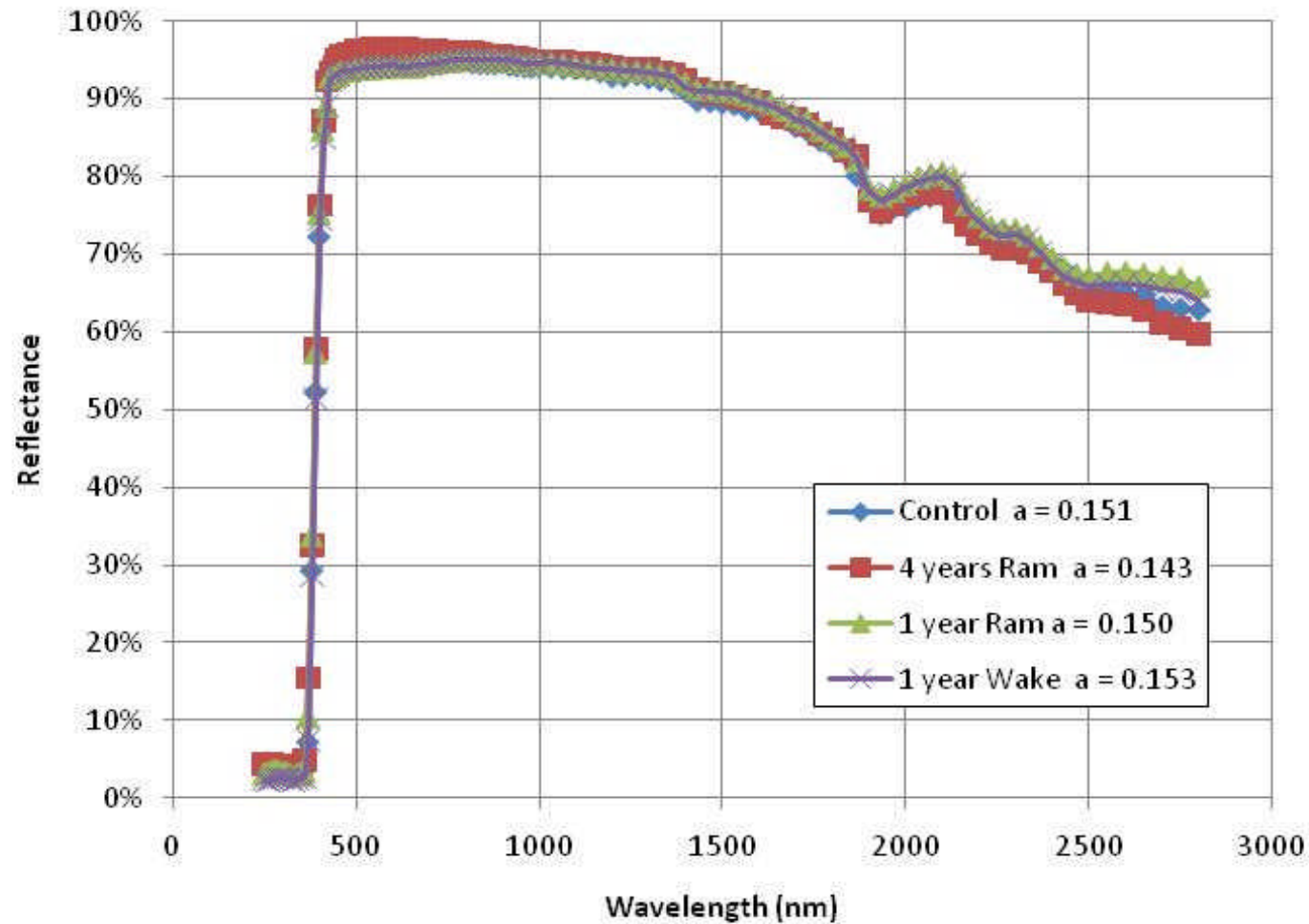
### Wake-facing side

- $\sim 1.4 \times 10^{20}$  atoms/cm<sup>2</sup> atomic oxygen (Kapton erosion)
  - $\sim 1,950$  equivalent sun-hours UV
- >8,400 thermal cycles of +40/-40 °C

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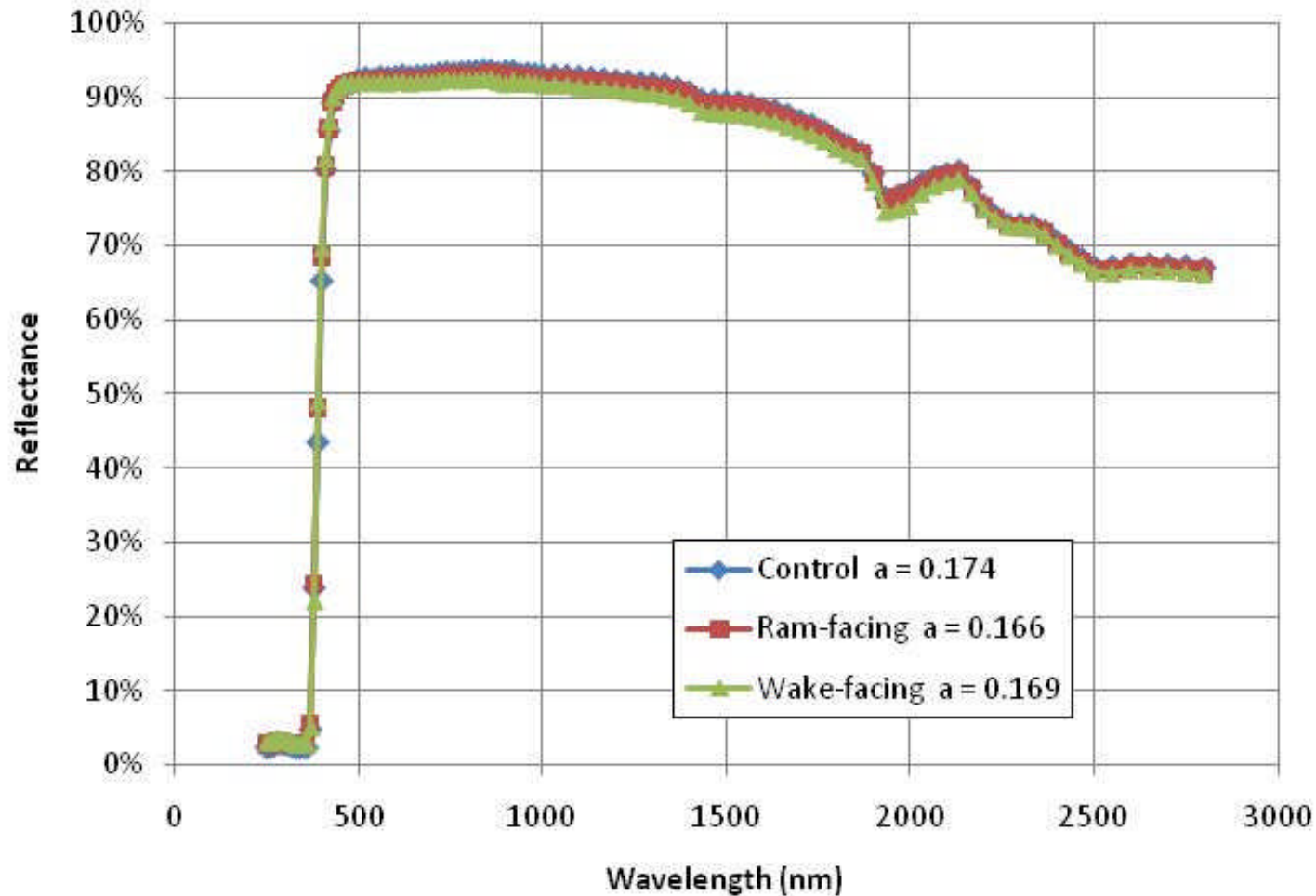
### MISSE AZ93



## Thermal Control Materials on MISSE-6 With Comparison to Earlier Flight Data



### MISSE-6 AZ93

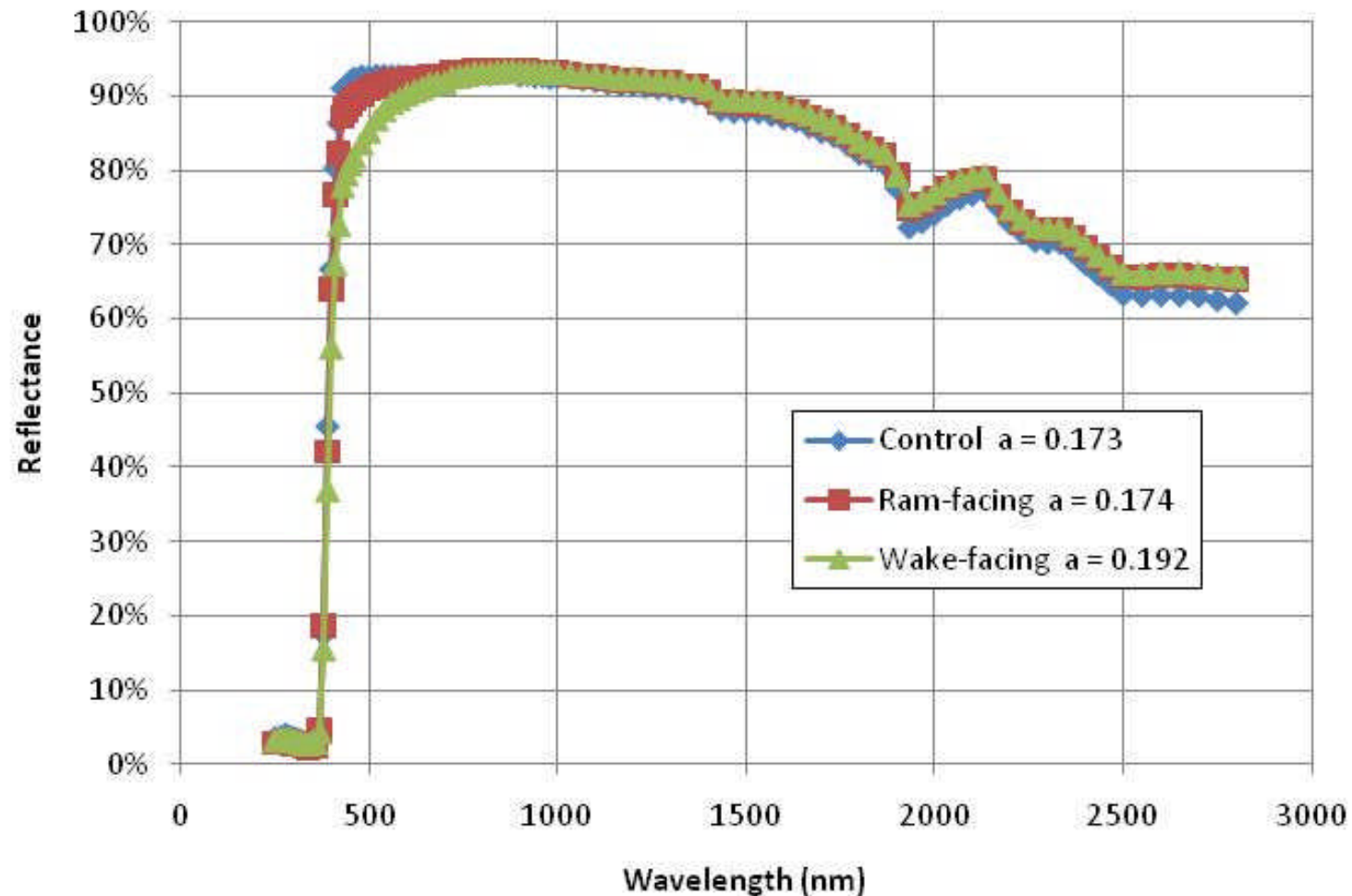




## Thermal Control Materials on MISSE-6 With Comparison to Earlier Flight Data



### MISSE-6 AZ93 with Teflon overcoat

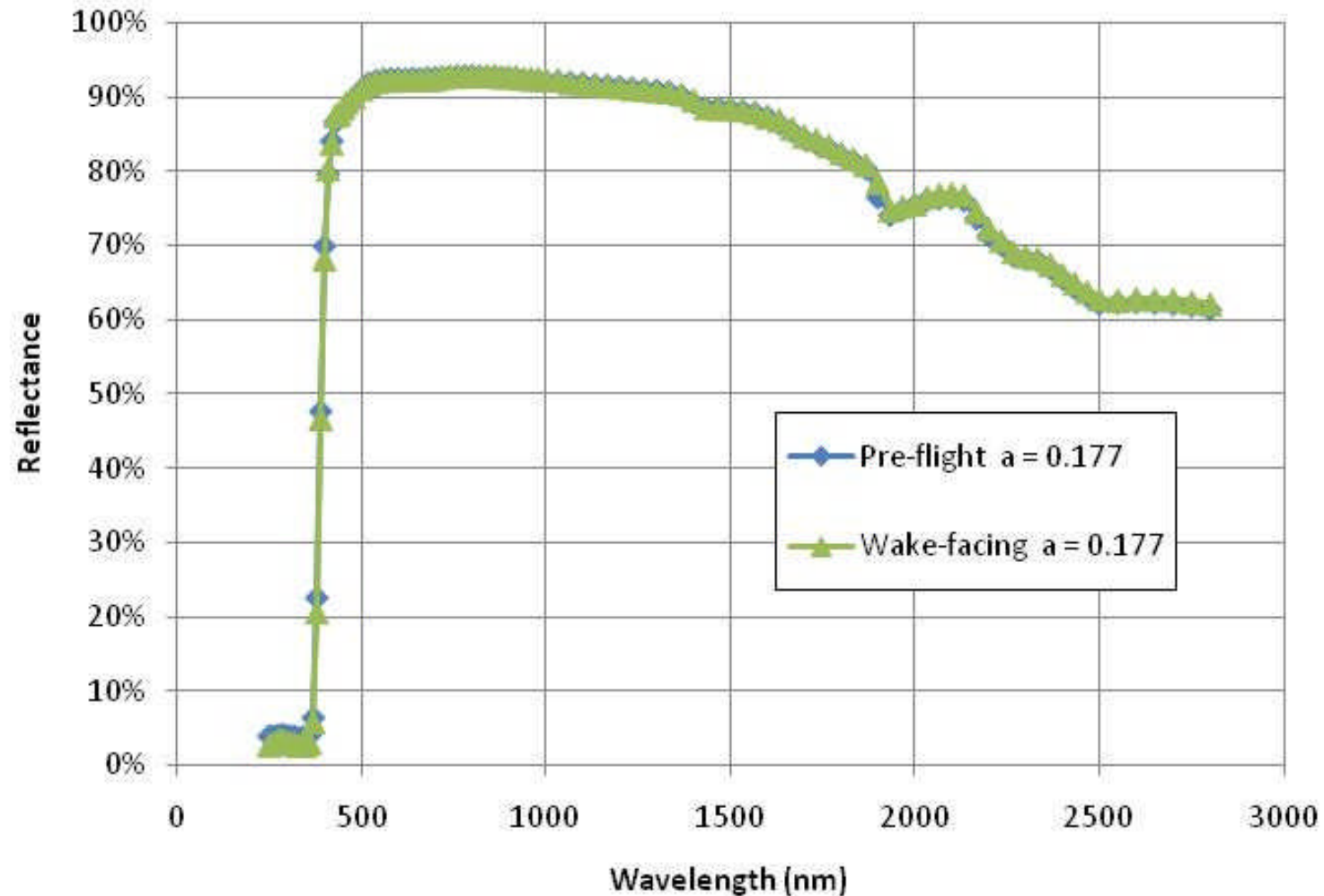


Samples from MISSE-3 and -4 also ranged from 0.17 to 0.19 in solar absorptance

## Thermal Control Materials on MISSE-6 With Comparison to Earlier Flight Data



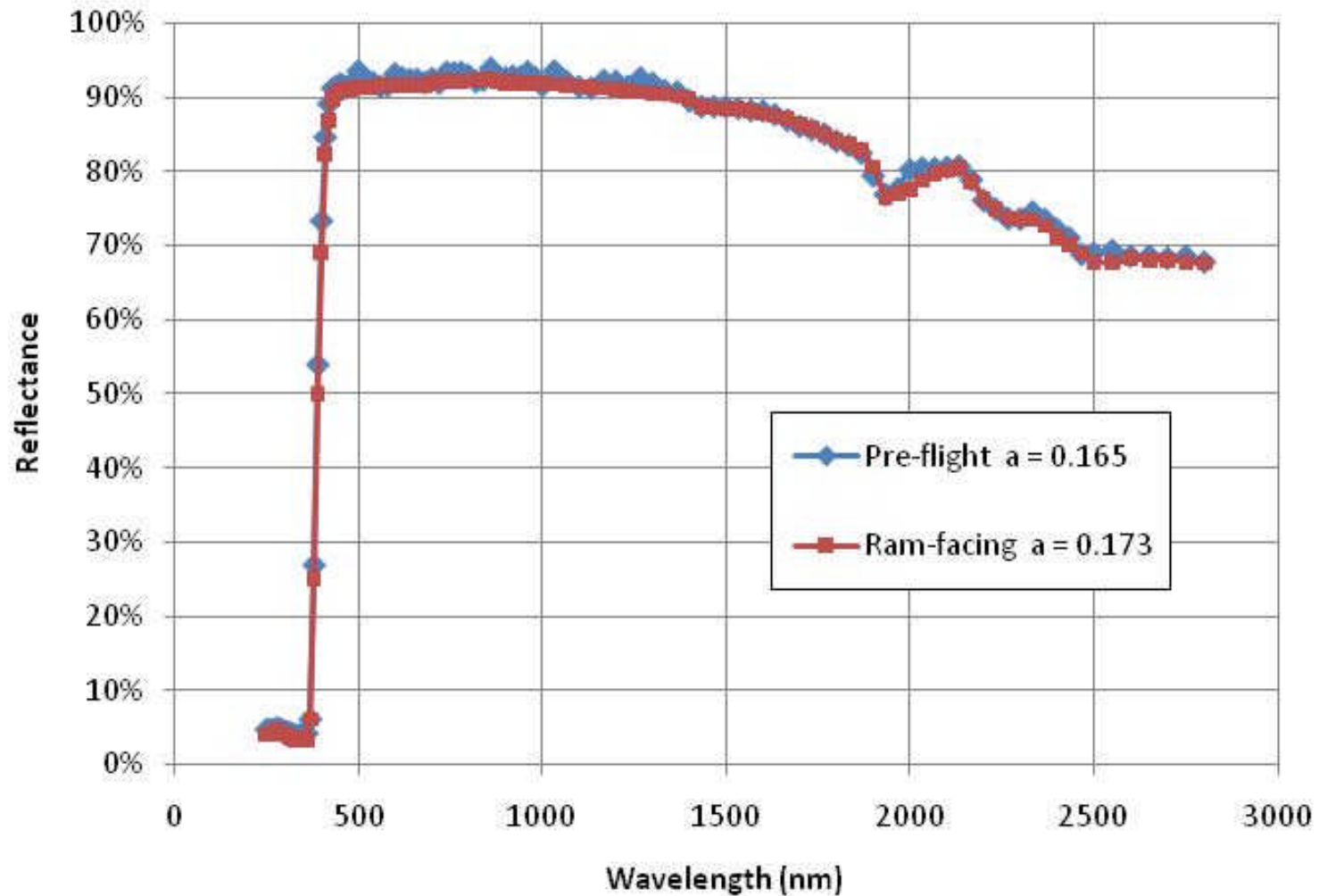
### MISSE-6 AZ93 on Kapton



## Thermal Control Materials on MISSE-6 With Comparison to Earlier Flight Data



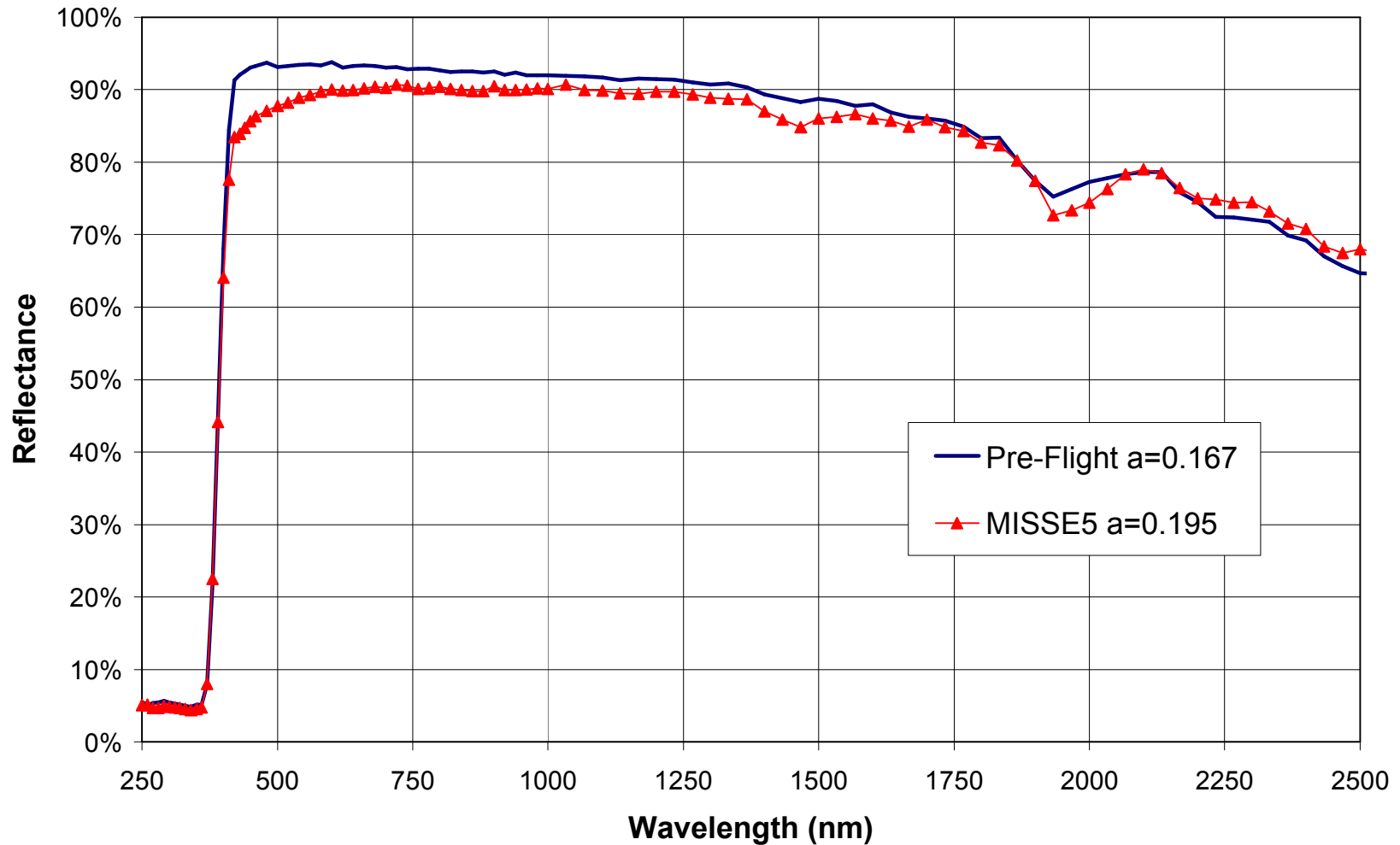
### MISSE-6 AZ93 on beta cloth



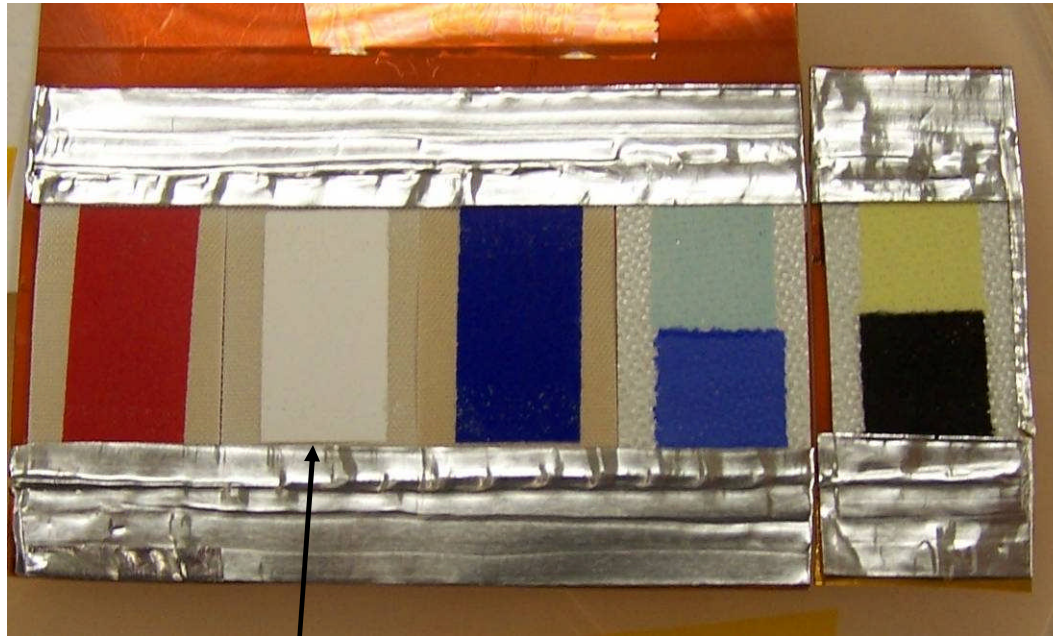
Thermal Control Materials on MISSE-6  
With Comparison to Earlier Flight Data



**MISSE-5 AZ93 on Beta Cloth**  
No Aluminization



## Thermal Control Materials on MISSE-6 With Comparison to Earlier Flight Data



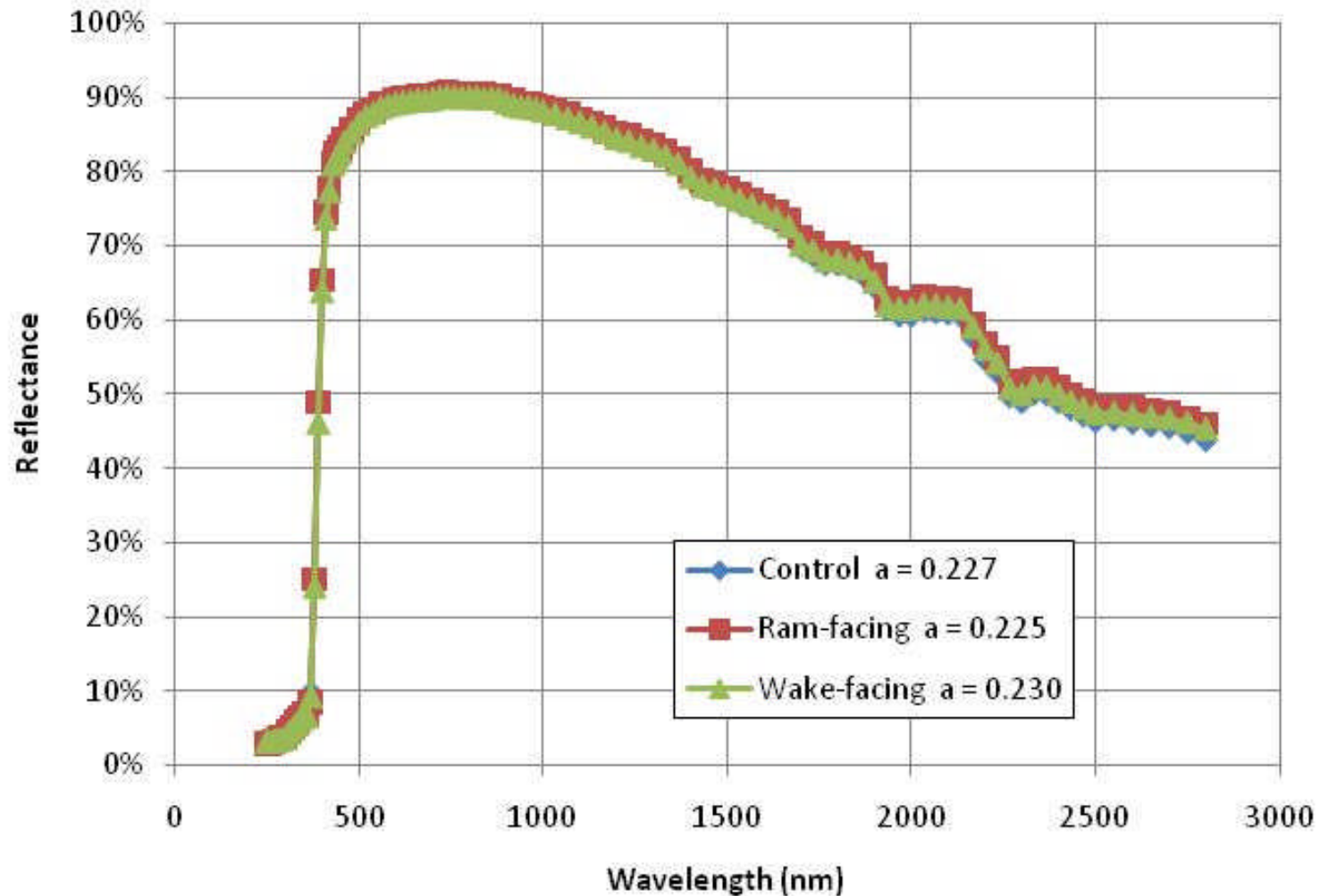
Previously flown AZ93 on Beta Cloth on MISSE-5.  
Change in reflectance spectra may indicate darkening of  
beta cloth underneath coating.  
MISSE-6 AZ93 applied slightly thicker.



## Thermal Control Materials on MISSE-6 With Comparison to Earlier Flight Data



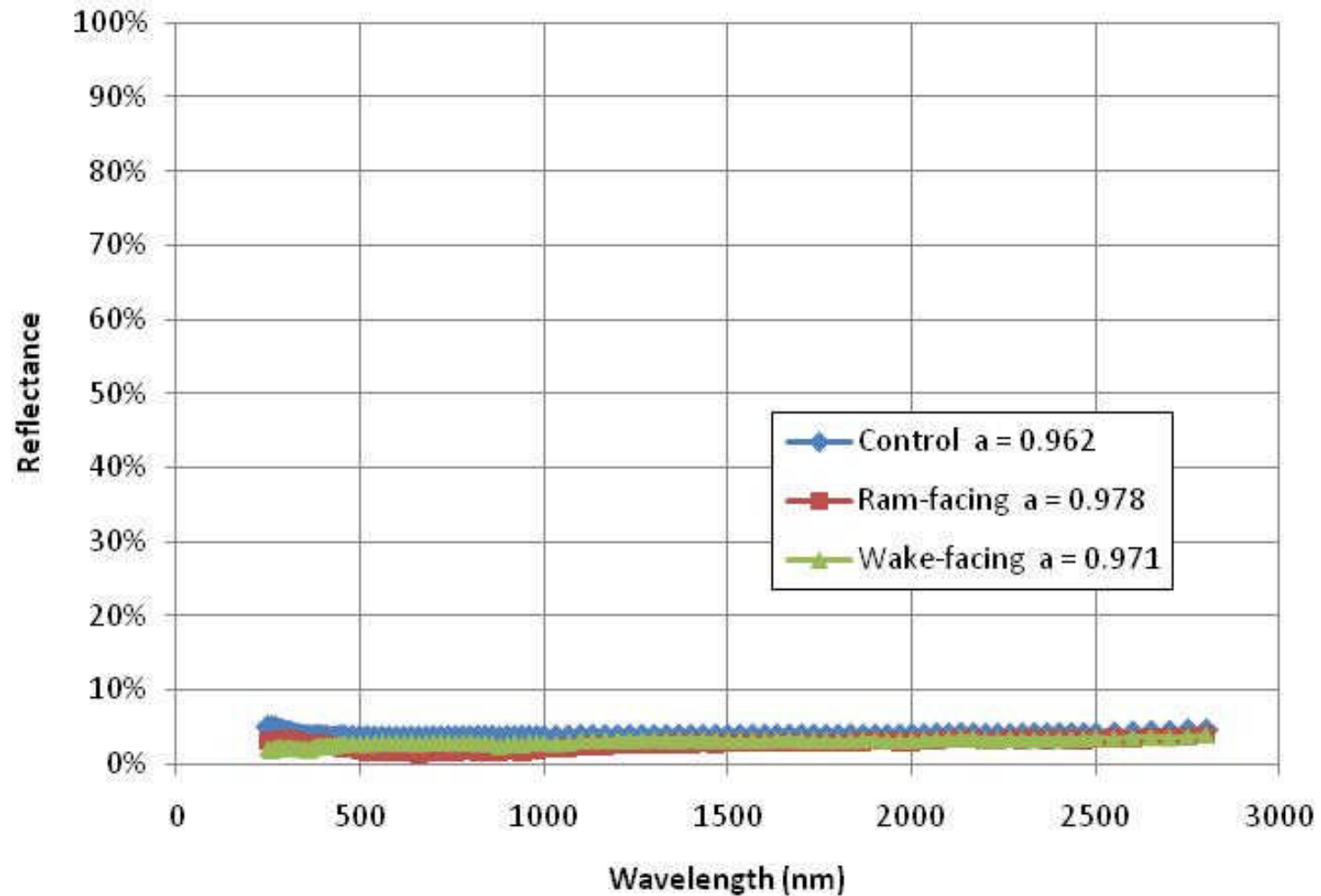
### MISSE-6 AZ400 conductive white



# Thermal Control Materials on MISSE-6 With Comparison to Earlier Flight Data



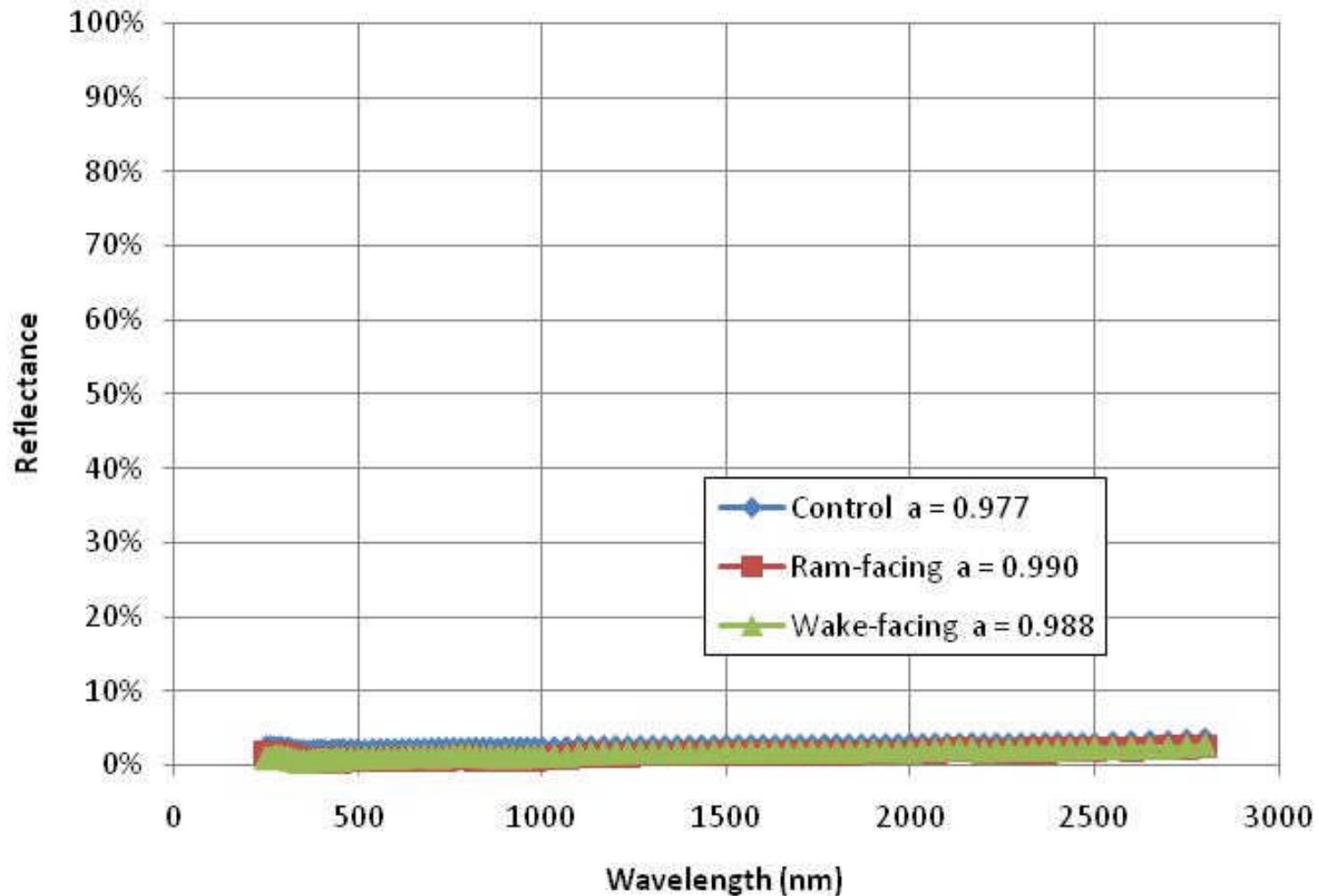
## MISSE-6 MLS-85-SB



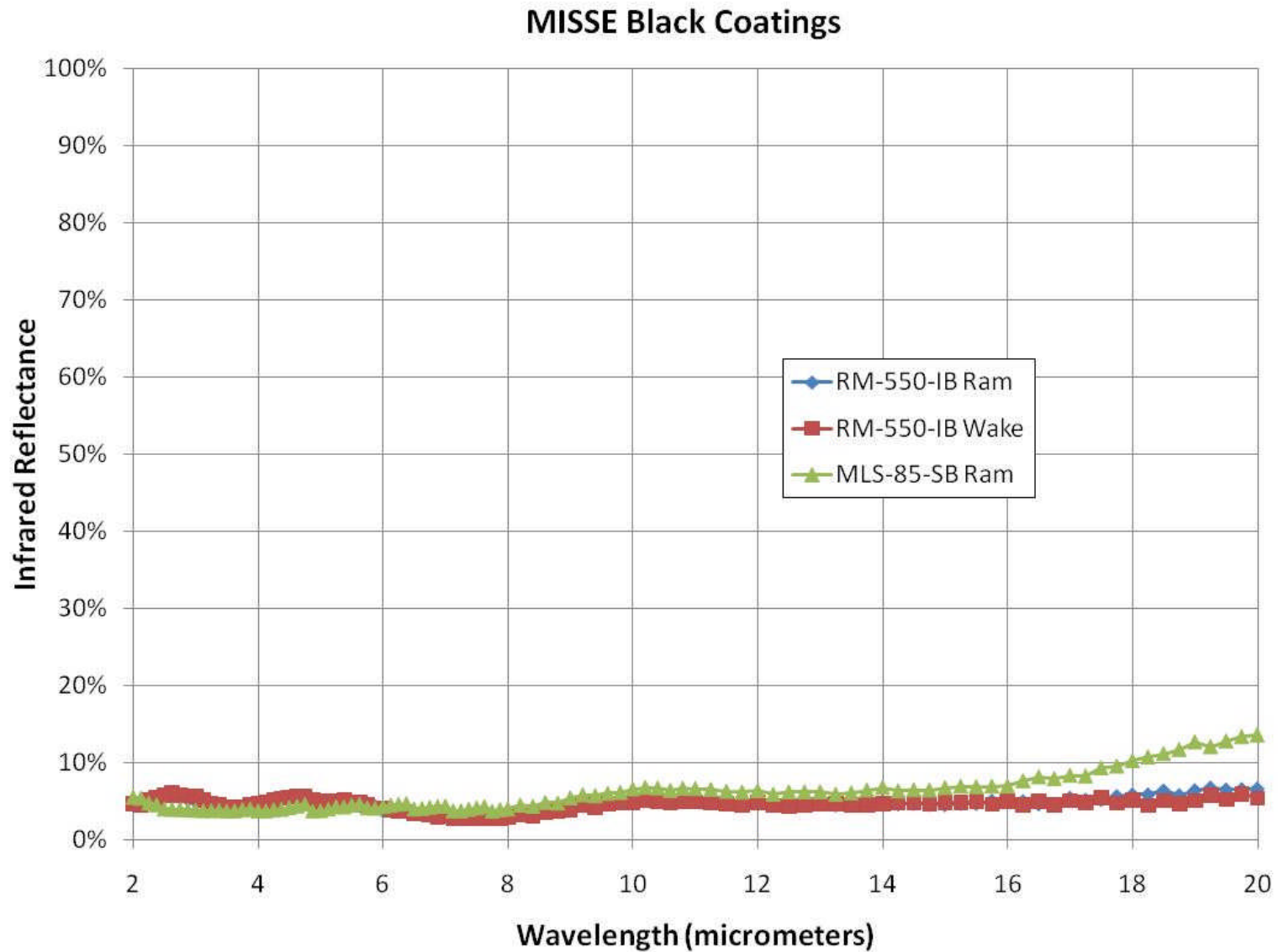
Thermal Control Materials on MISSE-6  
With Comparison to Earlier Flight Data



## MISSE-6 MLS-85-SB conductive black



## Thermal Control Materials on MISSE-6 With Comparison to Earlier Flight Data





## Marker Coatings

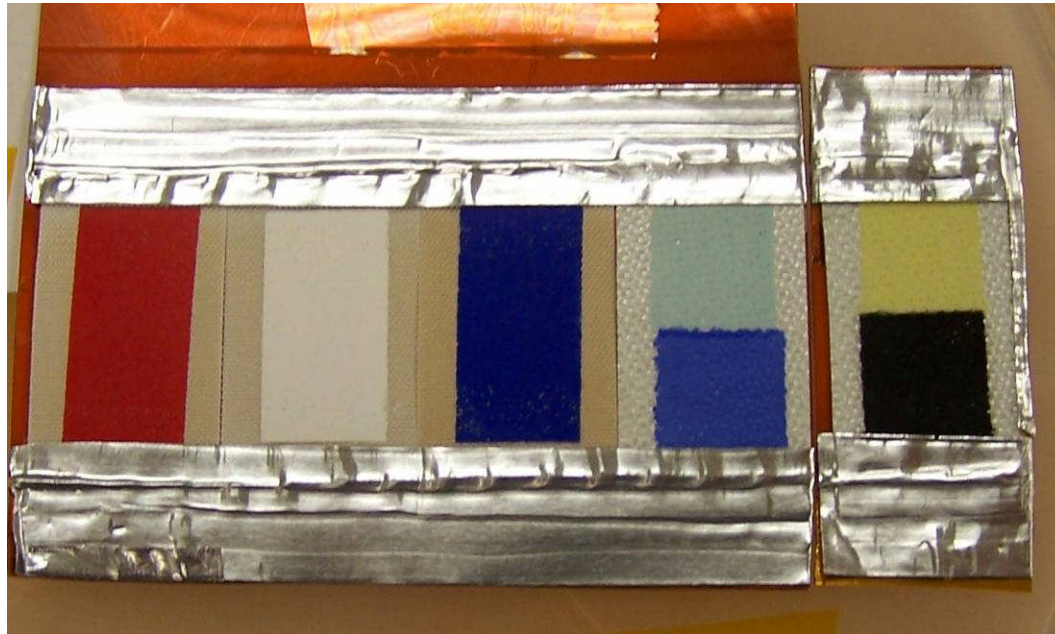
Comparison between MISSE-5 and MISSE-6

MISSE-5 Environmental Exposure for one year

- $\sim 1.8 \times 10^{20}$  atoms/cm<sup>2</sup> atomic oxygen
- $\sim 525$  equivalent sun-hours UV
- $>6,500$  thermal cycles of  $+40/-40$  °C

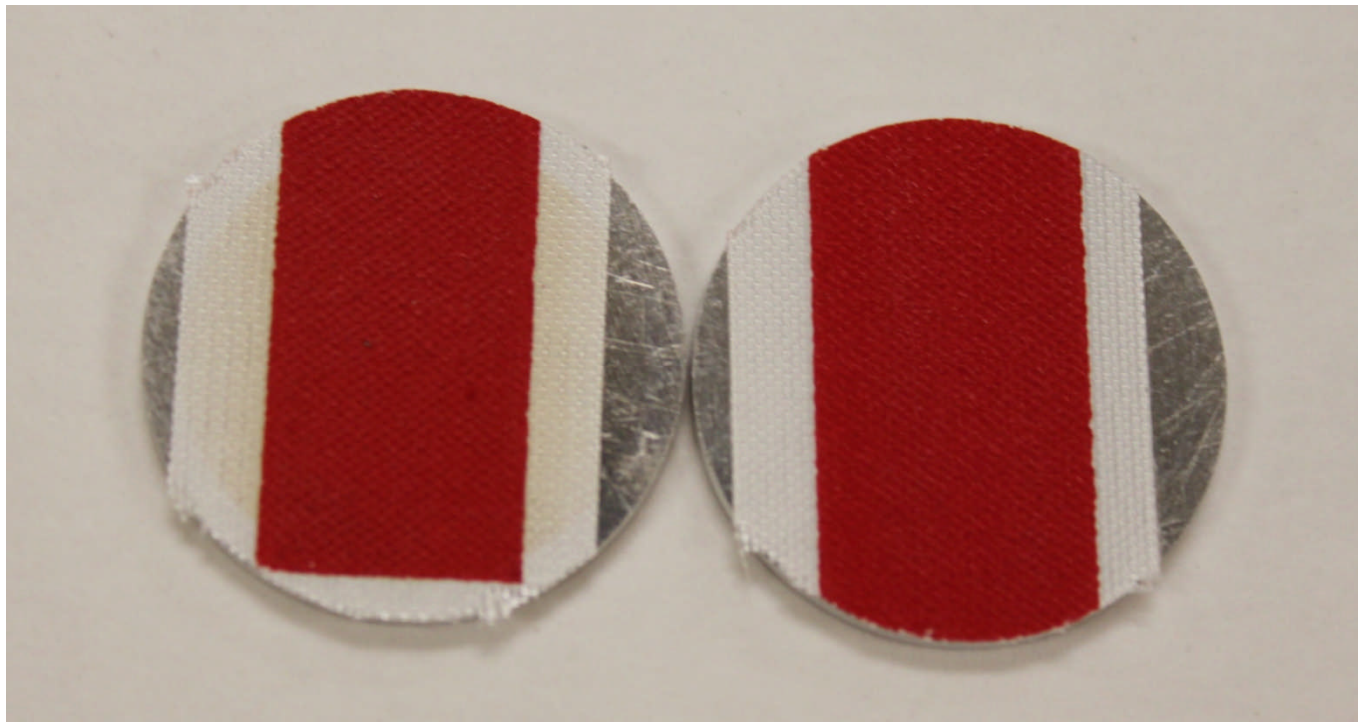


**Thermal Control Materials on MISSE-6  
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Left to right, AMJ600IR, AZ93, AMJ700IBU on beta cloth,  
AMJ760/AMJ750 , TMS800IY/TMJ-20LSB screen printed  
on Dutch glass cloth

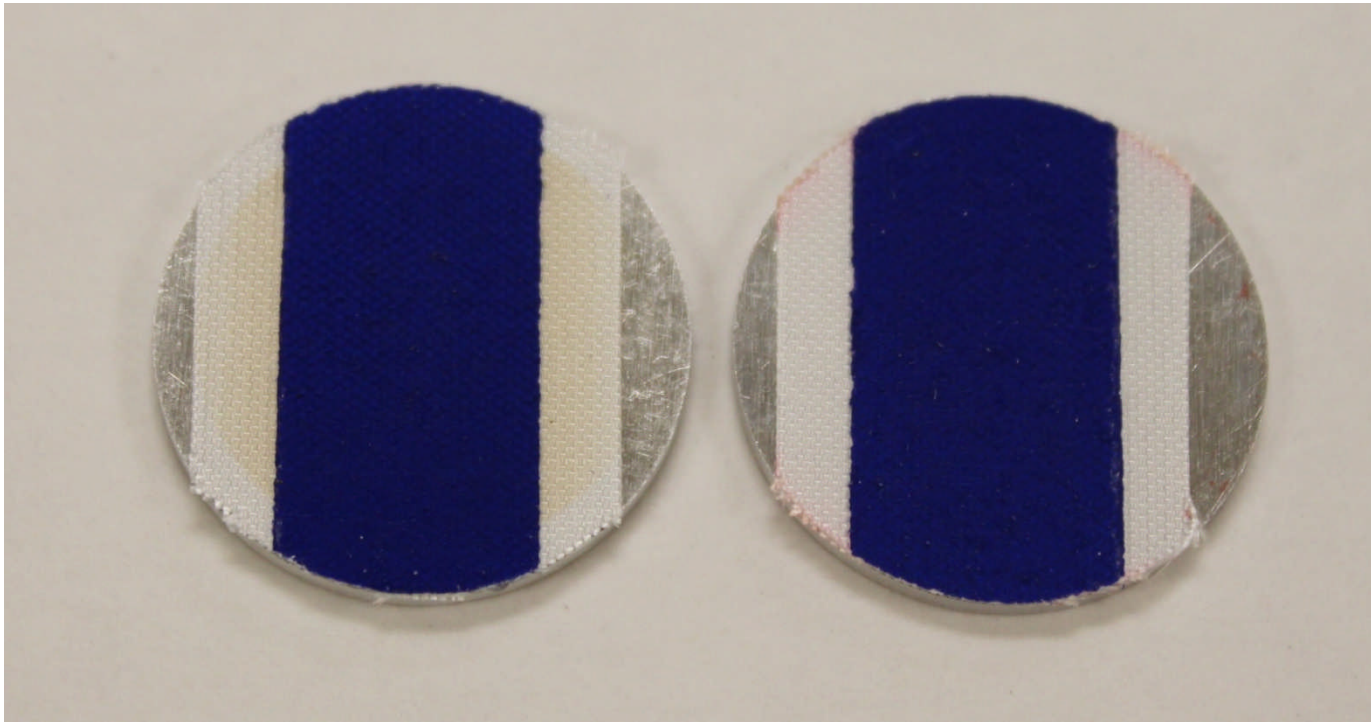
## Marker Coatings - AMJ600IR



Flight Ram-facing

Control

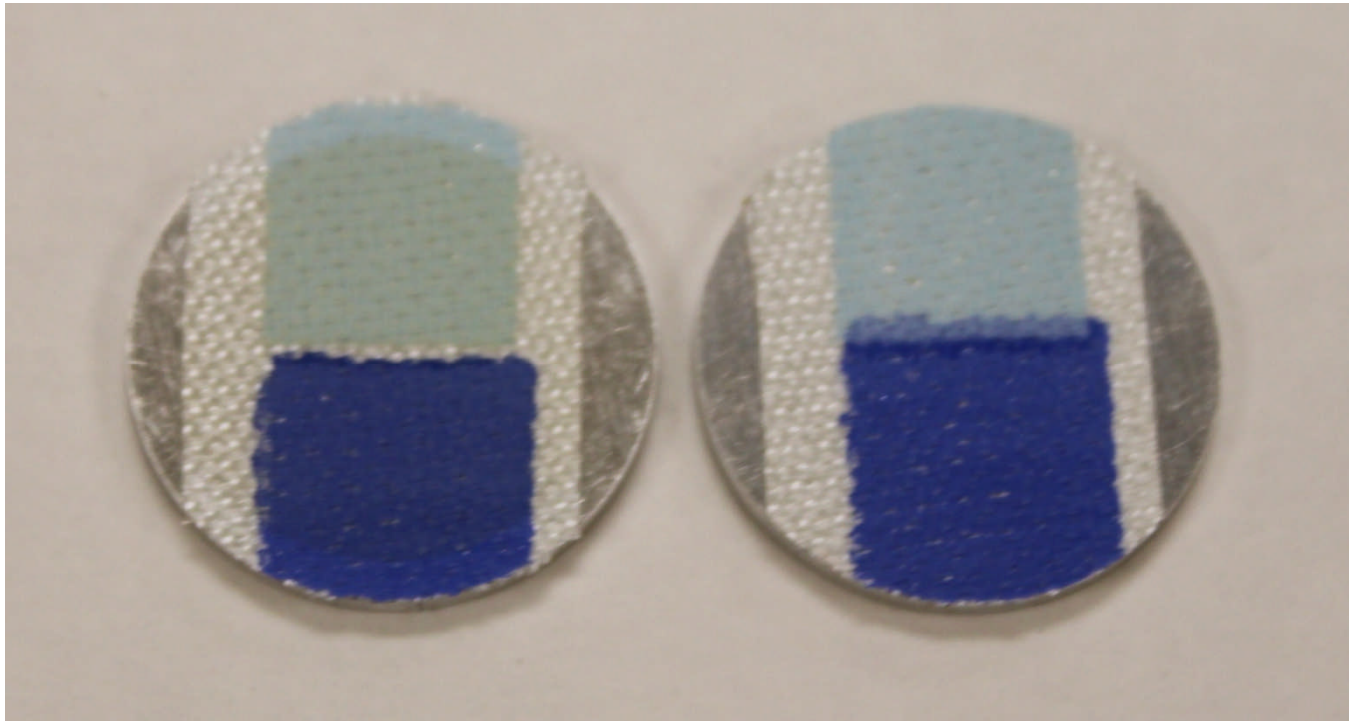
## Marker Coatings - AMJ700IBU



Flight Wake-facing

Control

## Marker Coatings - AMJ760/AMJ750

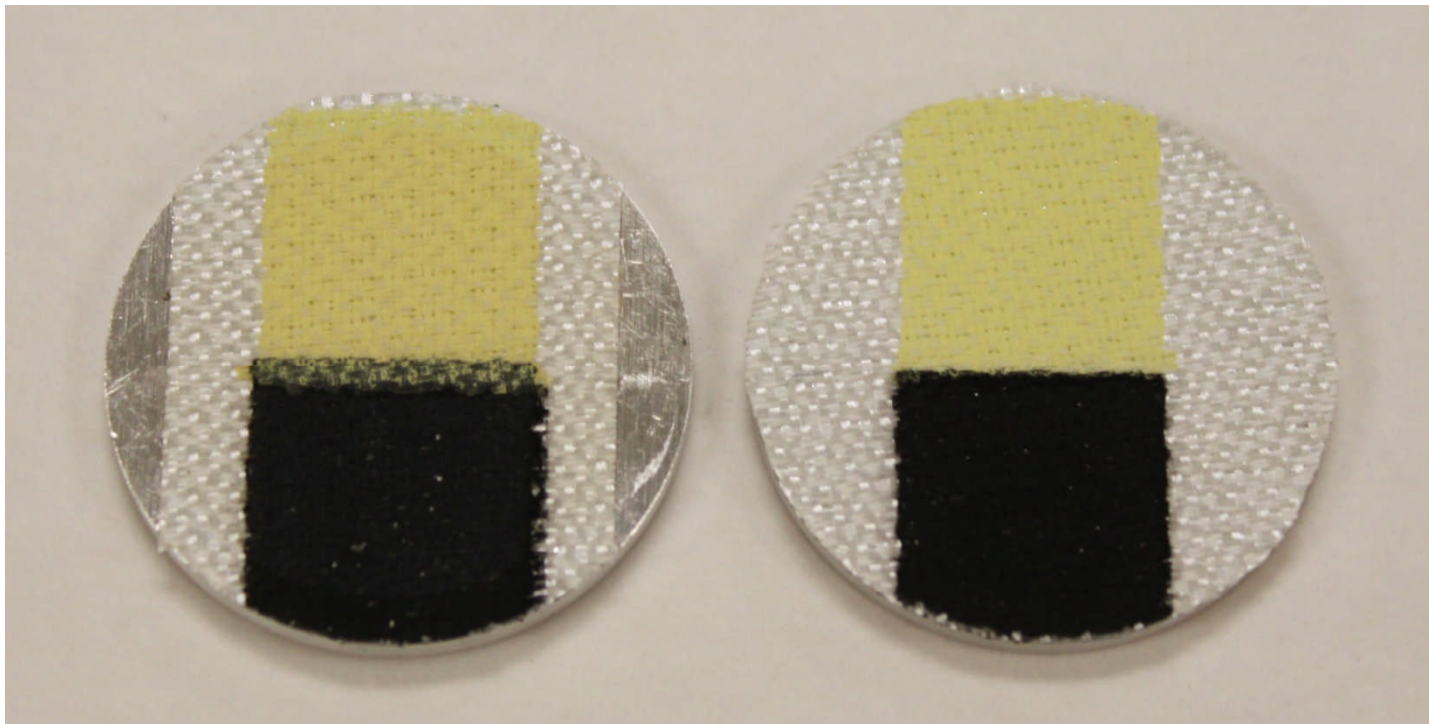


Flight Ram-facing

Control



## Marker Coatings - TMS800IY/TMJ-20LSB



Flight Ram-facing

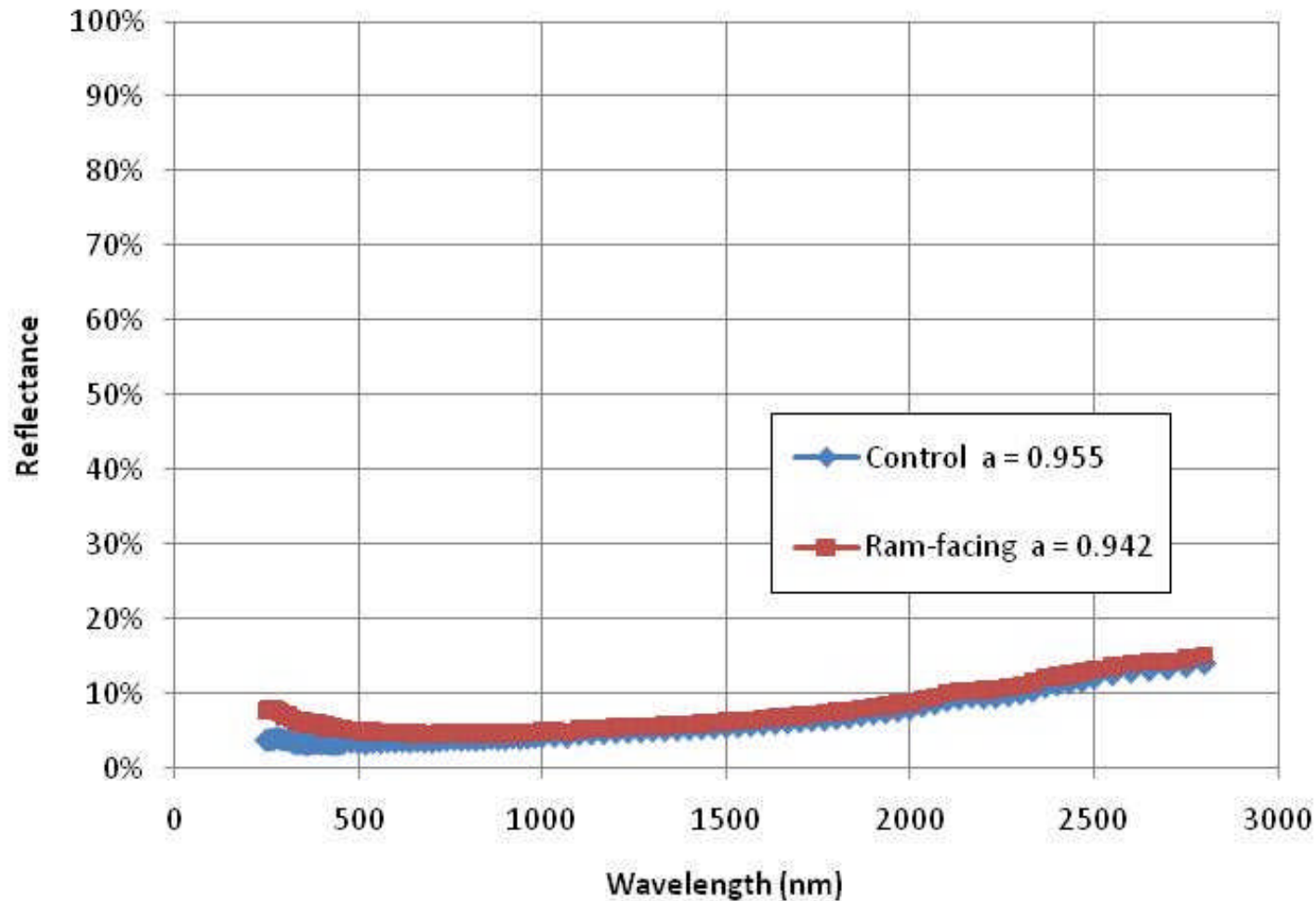
Control



## Thermal Control Materials on MISSE-6 With Comparison to Earlier Flight Data



### MISSE-6 TMJ-20-LSB on Dutch Glass Cloth





## **Conclusions**

- ◆ Coatings, particularly AZ93 zinc oxide pigment with inorganic binder, held up well in LEO {AO+UV} environment.
- ◆ No evidence of significant contamination.
- ◆ Marker / Label coatings maintained their color.
- ◆ Beta cloth darkened due to UV exposure. Solar absorptance was in agreement with previous MISSE exposure.
- ◆ Dutch glass cloth darkened slightly due to UV exposure.



## **MISSE-7 and MISSE-8**

- ◆ Continuing to fly AZ93 as contamination monitor on both MISSE-7 and MISSE-8.
- ◆ MISSE-7
  - ◆ AZ-400, AZ-2000-LSW, AZW/LAII, RM550IB on aluminum
  - ◆ AZ-3700 on Kapton with 3M 966 adhesive
- ◆ MISSE-8
  - ◆ AZ-400, AZ-2000-ICW, AZ-2000-LSW, AZ-2100-IECW white coatings
  - ◆ AZ-3700 metallic coating
  - ◆ MLS-85-SB-C, RM-550-LSB, RM-550-LSB-H, RM-550-LSB-C, RM-550-IB black coatings



## **Acknowledgments**

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